Trim Optimization

Professor Ali Can TAKİNACI

Istanbul Technical University Naval Architecture and Ocean Engineering Faculty

27th ITTC Resistance Committee Member (2011-2014)

26th ITTC Wake Scaling Committee Member (2008-2011)

Trim Optimization & SEEMP

ANNEX 9

RESOLUTION MEPC.213(63)

Adopted on 2 March 2012

2012 GUIDELINES FOR THE DEVELOPMENT OF A

SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP)' optimized ship handling

Optimum trim

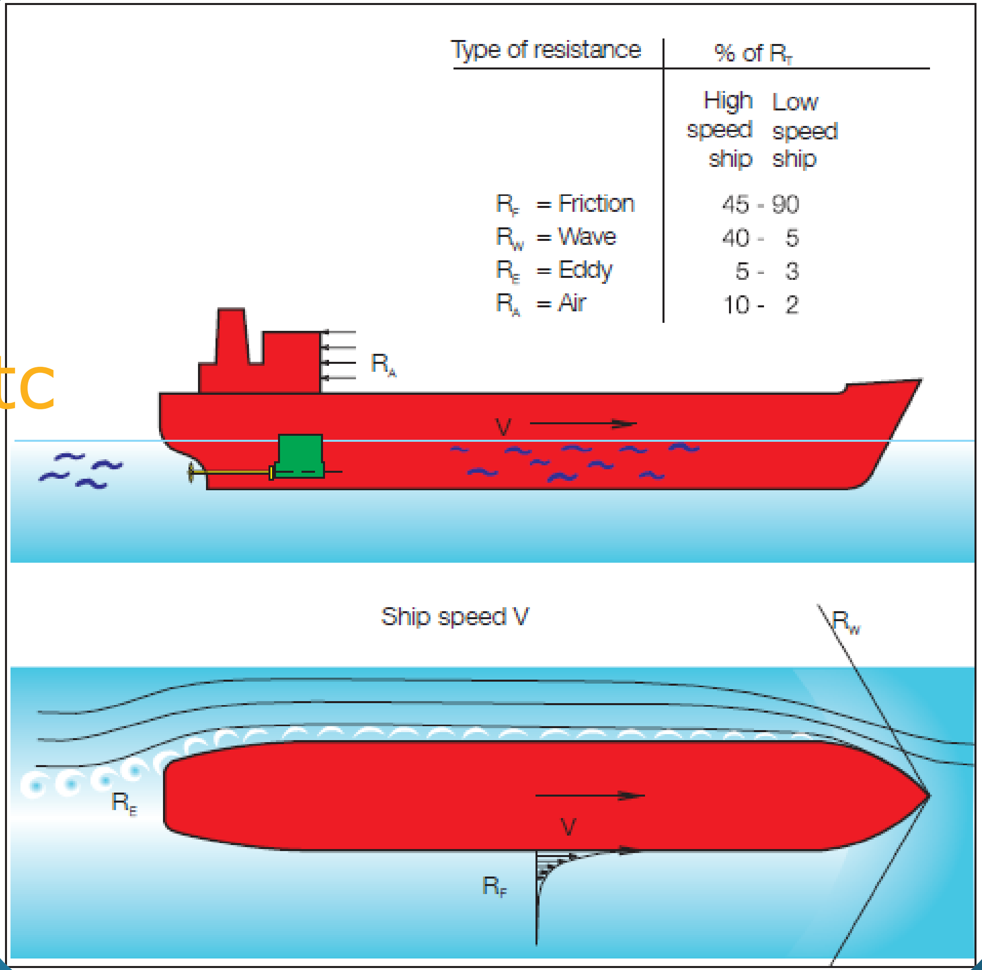
5.12 Most ships are designed to carry a designated amount of cargo at a certain speed For a certain fuel consumption. This implies the specification of set trim conditions. Loaded or unloaded, trim has a significant influence on the resistance of the ship through the water and optimizing trim can deliver significant fuel savings. For any given draft there is a trim condition that gives minimum resistance.

In some ships, it is possible to assess optimum trim conditions for fuel efficiency continuously throughout the voyage.

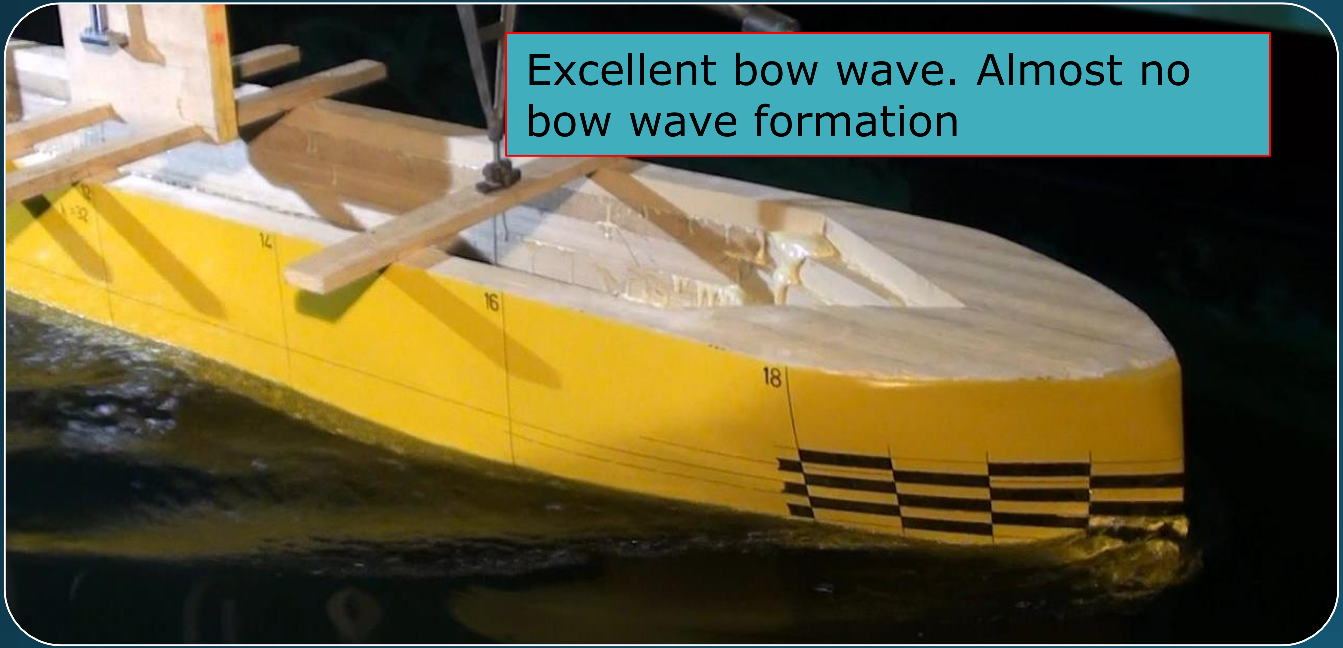
Design or safety factors may preclude full use of trim optimization.

Elements of Ship Resistance

i. Friction
ii. Wave
iii. Vorticity + Flow Separation etc
iv. Air
v. Incriment due to fouling

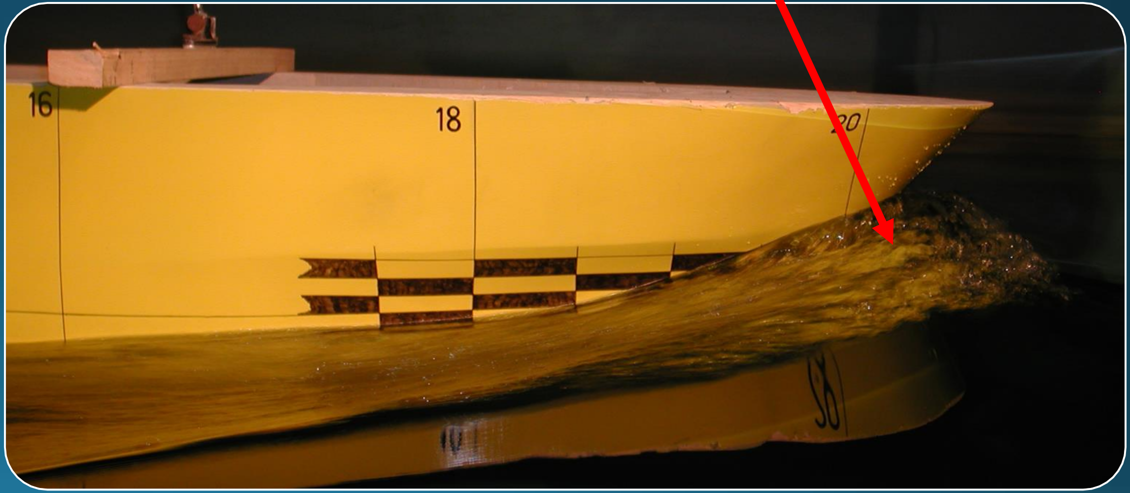


Good and Bad Wave Formations



Excellent bow wave. Almost no bow wave formation

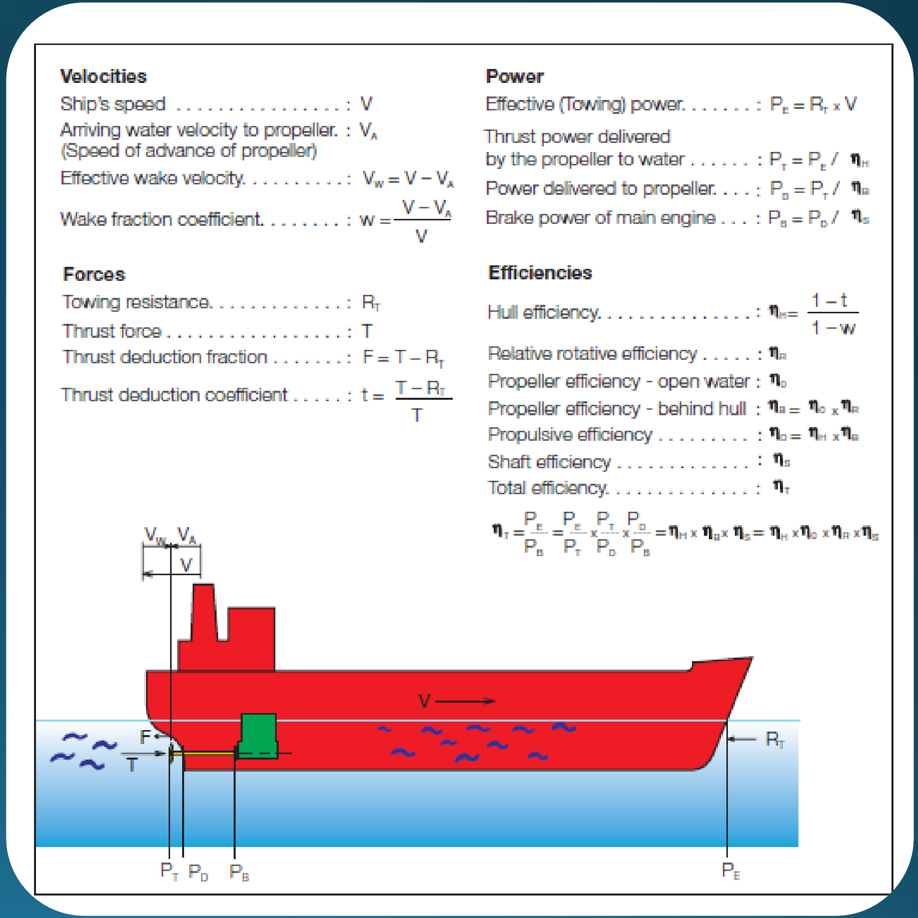
Wave breaking



Designed by KAZIM KURTOĞLU
Norden Design House

Elements of Ship Propulsion

Power losses from engine to propeller in every device

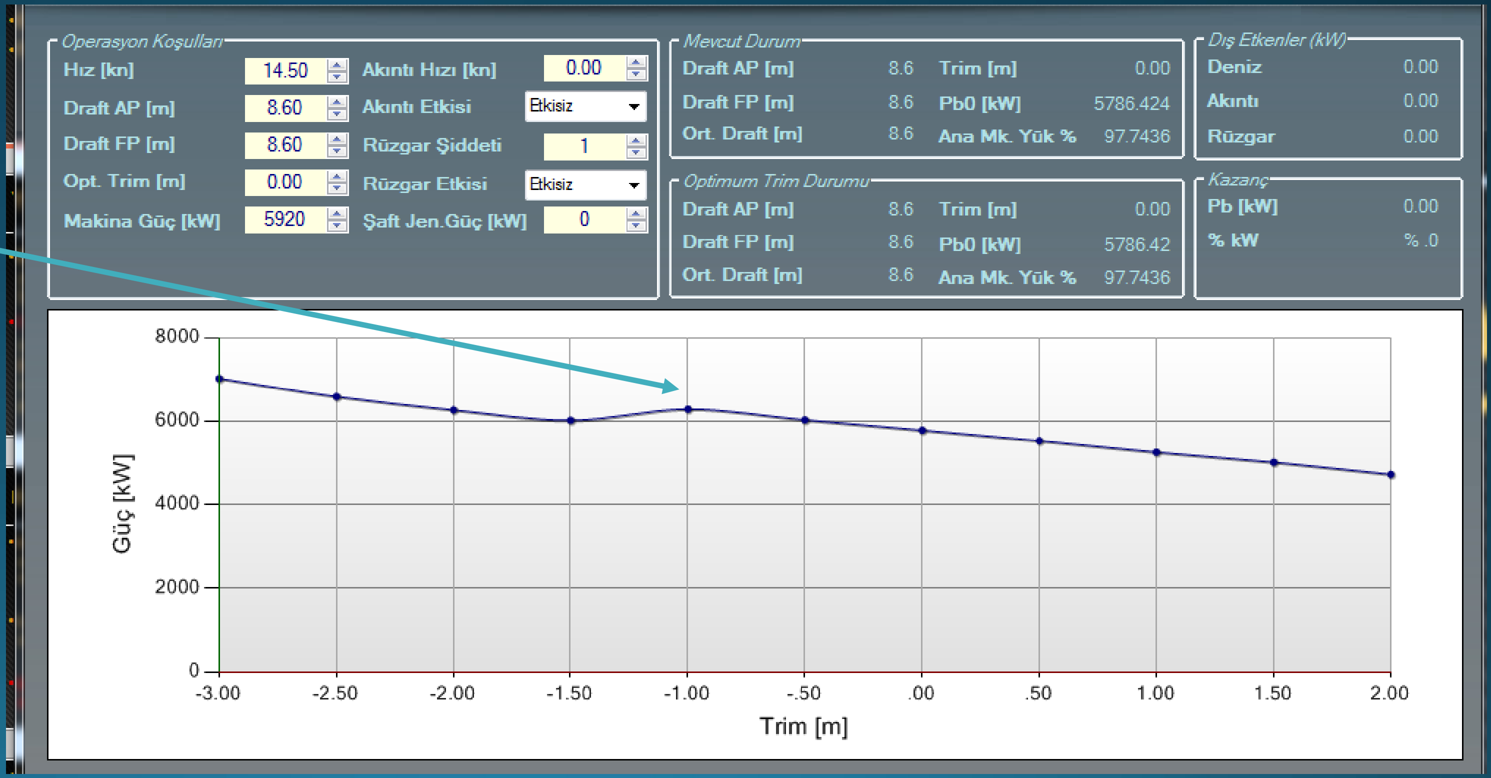


What does Trim Optimization do?

- Only wave resistance can be controlled by trim.
- Controlling the angle of entrance
- Controlling the underwater body of ship.
- Trim can be controlled under the restriction of current loading.

Misbelief-1

- Trim to aft is better.
- Nonsense.
- Changes according to trim condition.



Misbelief -2

- Because my ship makes «squat» I prefer trim to aft. Your software is wrong !!!
- No !! In the first place, squat takes place either in shallow water or canal.
- Dynamic trim takes places in deep water.
- If the ship is not in scantling loading, the effect of dynamic trim can totally be ignored.

What is the choice?

- The only true is the towing tank test report.
- But, if the ship is in partial loading, situation may change
- The truth is the determination of trim according to bot loading and speed.

What Trim Optimization Do?

- It warns the captain or company before loading.
- The amount of load is approximately known before loading.
- Therefore the optimal trim condition would be detected before reaching loading port.

How Trim Optimization Works?

- Captain or ship management office can have knowledge about optimal trim condition in accordance with pre-defined scenarios.

- This needs only a simple software.

- The most important thing is the simplicity and user-friendliness.

What Trim Optimizasation needs ;

1. Ship hullform(Linesplan, 3D Surface Form ..)

2. Towing tank test report

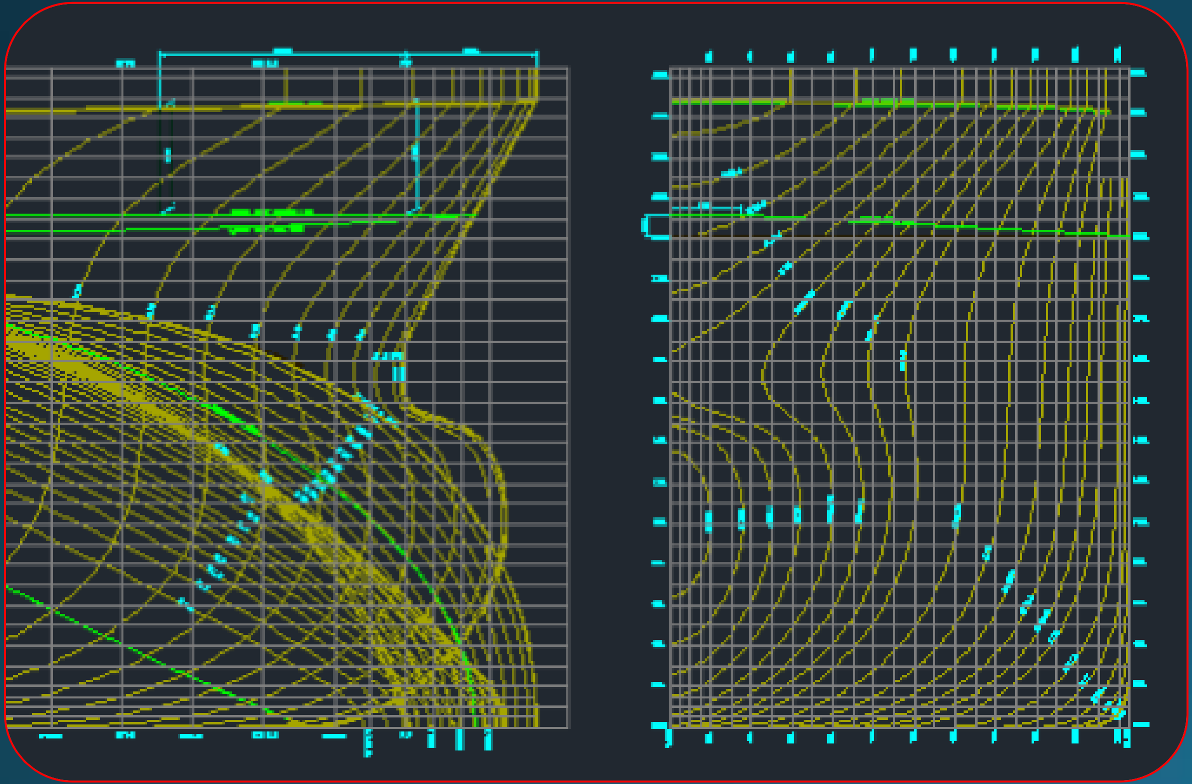
3. Propeller Plan

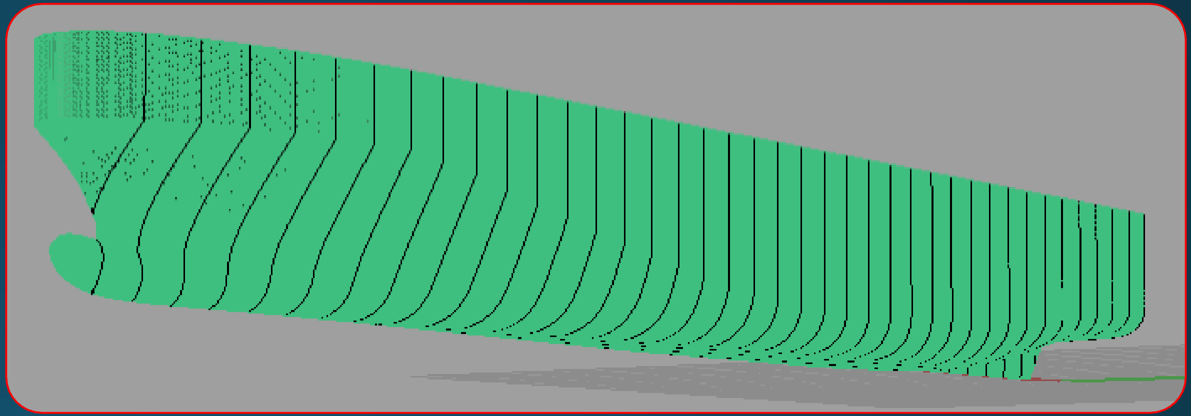
4. Main Engine details

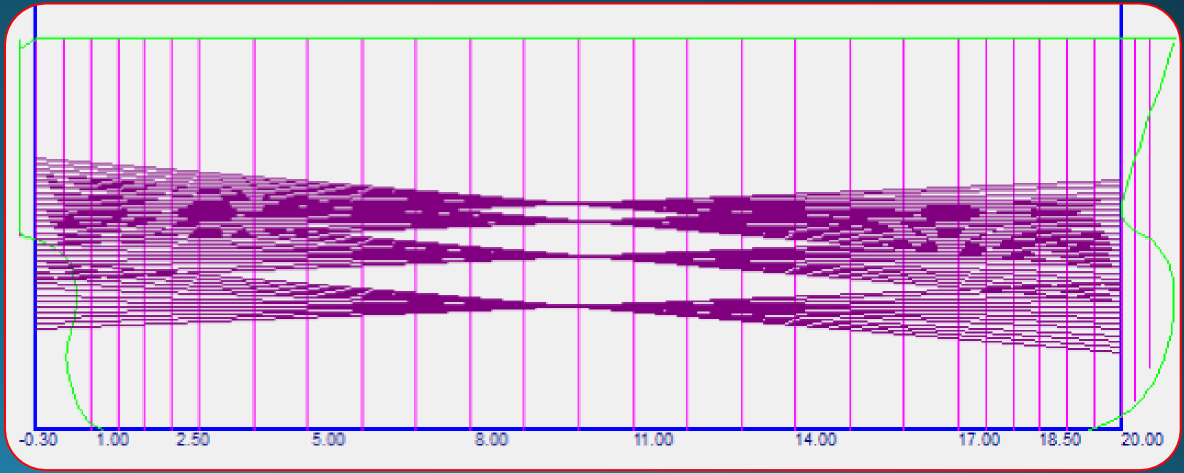
5. Voyage data (Noon Reports)

1. Ship Hull Form

- It needs for instant hydrostatic computing.

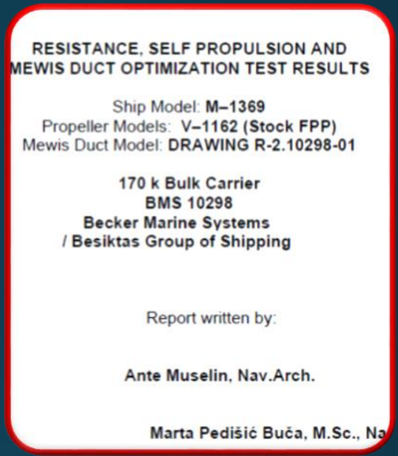






2. Topwing Tank test Report

Essential source for ship's performance.



RESISTANCE, SELF PROPULSION AND
MEWIS DUCT OPTIMIZATION TEST RESULTS

Ship Model: **M–1369**
Propeller Models: **V–1162 (Stock FPP)**
Mewis Duct Model: **DRAWING R-2.10298-01**

170 k Bulk Carrier
BMS 10298
Becker Marine Systems
/ Besiktas Group of Shipping

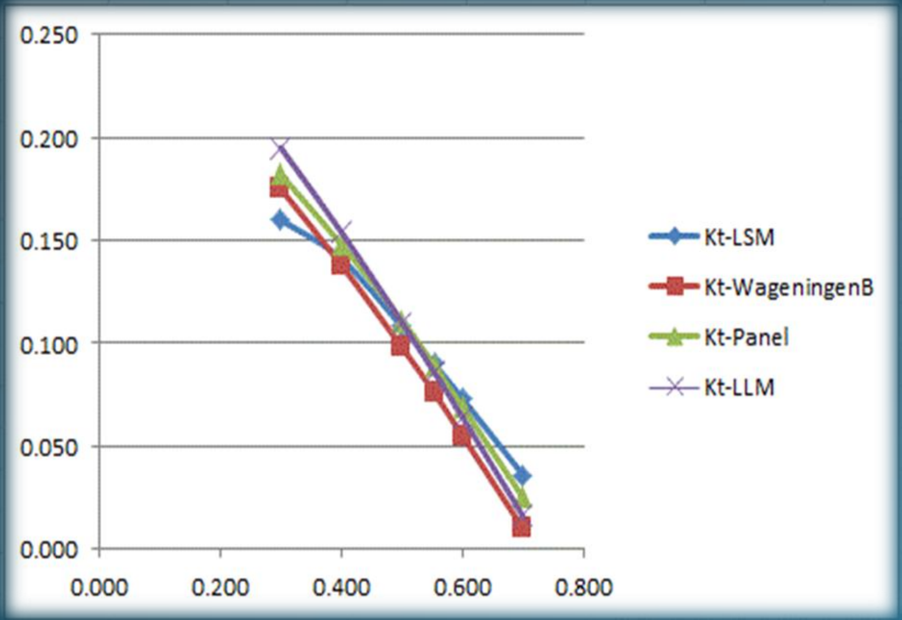
Report written by:

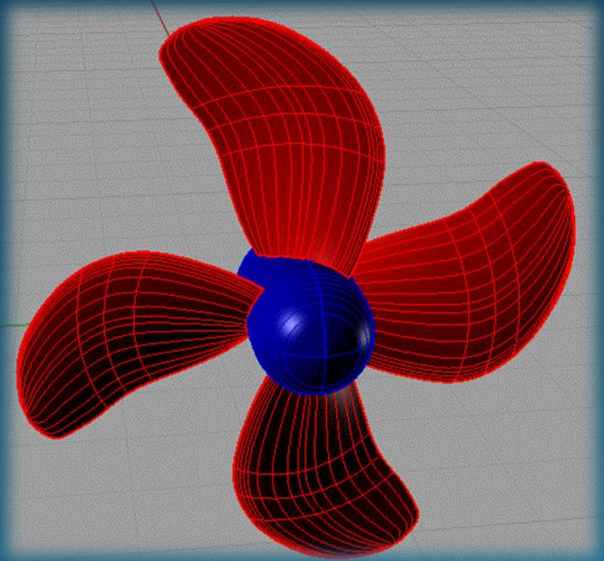
Ante Muselin, Nav.Arch.

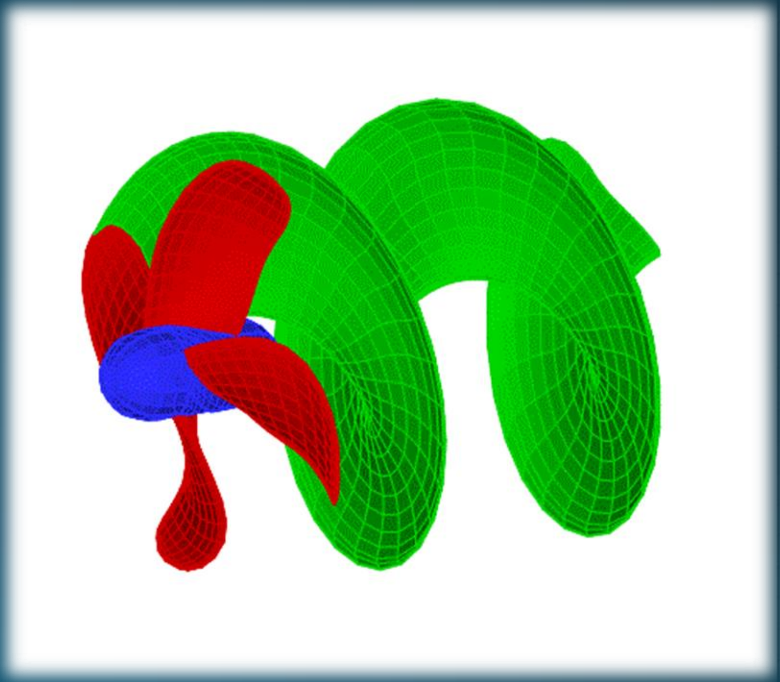
Marta Pedišić Buča, M.Sc., Na

3. Propeller Plan

Hydrodynamic performance prediction of propeller is indispensable part of trim optimization since the most important parameter of determining the power is the propeller.







4. Main Engine Details

- Engine layout diagrams and reduction gear ratio is used in prediction and control of power required.

5. Noon Reports (Voyage Data)

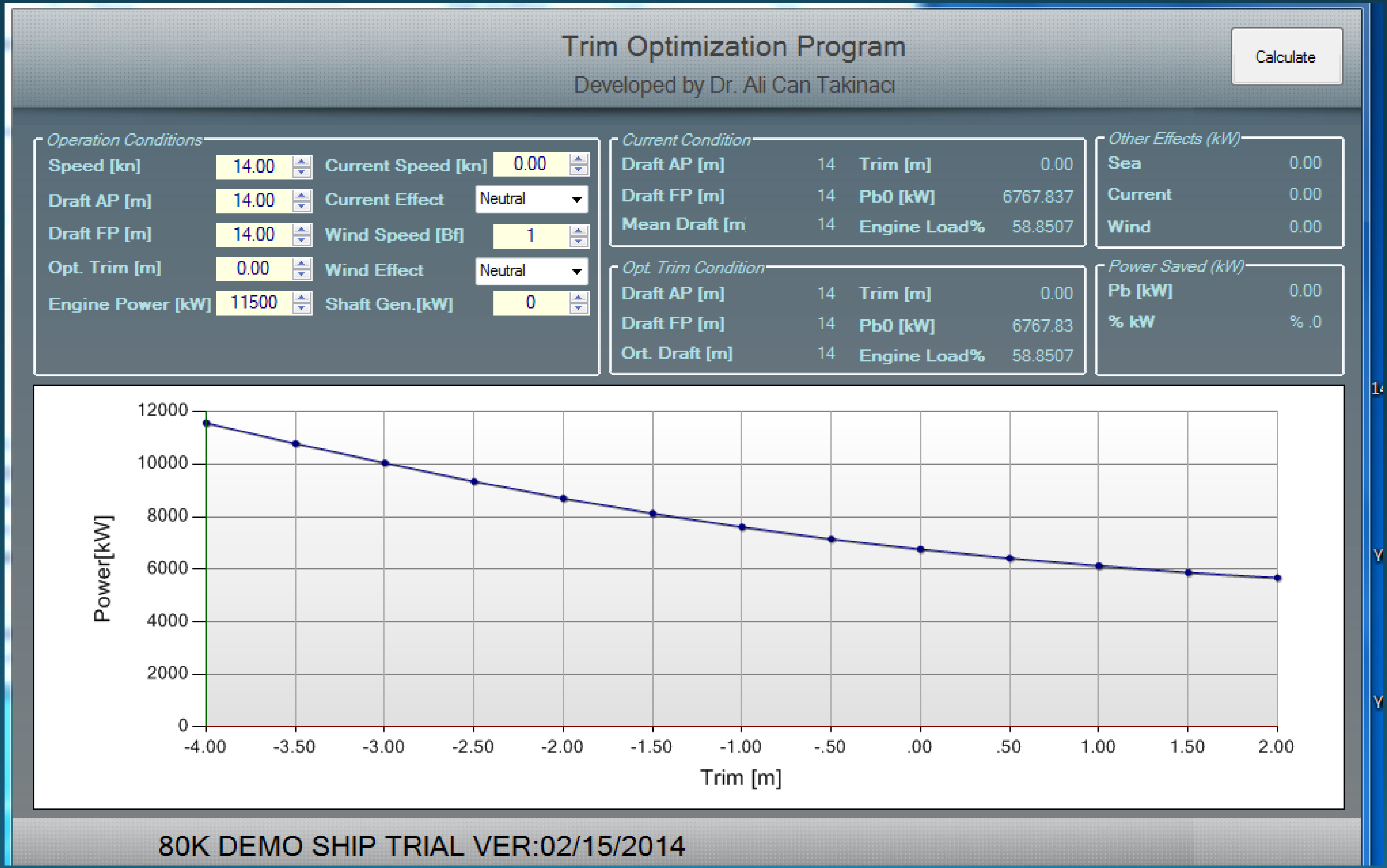
- Essential data for checking the sofware.

PASSAGE PEFORMANCE

Voy:05/12-B
From: Singapore
To:Puerto Drummond
Condition: Ballast
Ordered Speed: Economy

	DRAFTS													Wind Condition		Sea Condition		MAIN ENGINE			
Date&Time	F	A	Trim	St. Hours	DTG	St. Dist	Speed	RPM	Load	Pitch	Eng.Speed	Slip	Hdg	Dir	Force	Dir	Height	HSFO	LSFO	MGO	LSMGO
COSP:14.07-0136																					
NOON 14.08.12	8.66	10.99	2.33	25	2442	329	13.16	73.28	50		14.23	7.50		SE	6	SE	3.5	45.79			
NOON 15.08.12	8.66	10.99	2.33	24	2125	334	13.92	73.40	48		14.25	2.30		SE	5	SE	2.5	43.95			
NOON 16.08.12	8.66	10.98	2.32	24	1757	333	13.87	73.18	48		14.21	2.38		SE	5	SE	2.0	43.88			
NOON 17.08.12	8.66	10.98	2.32	25	1422	335	13.4	73.30	48		14.23	5.8		SE	5	SE	2.0	45.74			
NOON 18.08.12	8.66	10.98	2.32	24	1084	338	14.08	73.10	49		14.19	2.75		SE	4	SE	1.5	43.91			
NOON 19.08.12	8.66	10.98	2.32	24	754	330	13.75	73.36	48		14.24	3.5		E	7	E	4.0	43.95			
NOON 20.08.12	8.70	10.90	2.20	25	415	339	13.56	73.20	50		14.21	4.6		E	5	E	2.0	45.86			
NOON 21.08.12	8.70	10.90	2.20	24	4103	325	13.54	74.70	50		14.50	6.6		SW	5	SW	2.0	45.61			
NOON 22.08.12	8.70	10.90	2.20	25	3744	359	14.36	75.04	56		14.57	1.4		SW	6	SW	2.5	48.80			
NOON 23.08.12	8.70	10.80	2.10	24	3422	322	13.42	75.3	51		14.60	8.2		SW	5	SW	1.5	46.97			
NOON 24.08.12	8.78	10.79	2.01	24	3086	338	14.08	75.5	52		14.66	3.9		SW	3	SW	1.0	46.20			
NOON 25.08.12	8.78	10.78	2.00	25	5527	250	10	73.41	58		14.25	29.9		SW	8	SW	6.0	48.97			
NOON 26.08.12	8.35	11.63	3.28	24	5278	290	12.08	74.21	50		14.41	16.1		SW	8,4	SW	6.0-4.0	45.96			
NOON 27.08.12	8.36	11.61	3.25	25	4931	350	14	75.52	50		14.66	4.5		SE	4	SE	3.0	46.7			
NOON 28.08.12	8.37	11.58	3.21	24	4590	342	14.25	75.12	48		14.59	2.3		SE	4	SE	2.5	44.12			
NOON 29.08.12	8.37	11.58	3.21	24	4246	344	14.33	74.9	50		14.54	1.47		E	4	E	2.0	43.98			
NOON 30.08.12	8.37	11.58	3.21	24	3896	351	14.62	76	51		14.7	0.9		SE	4	SE	2.0	46.17			
NOON 31.08.12	8.37	11.58	3.21	25	3540	356	14.24	74.55	50		14.47	1.6		E	4	E	2.0	45.05			

Trim Optimization Program



References

Ship's name	Ship's type	Capacity (DWT)
BESIKTAS AZERBAIJAN	Bulk Carrier	169300
BESIKTAS KAZAKHSTAN	Bulk Carrier	169300
BESIKTAS TURKMENISTAN	Bulk Carrier	180000
BESIKTAS BESIKTAS	Bulk Carrier	180000
BESIKTAS BOSPHORUS	Crude Oil Carrier	163750
BESIKTAS DARDANELLES	Oil Carrier	163750
BESIKTAS SCOTLAND	Chemical Imo II	180000
BESIKTAS ZEALAND	Chemical Imo II	180000
BESIKTAS HALLAND	Chemical Imo II	7700
BESIKTAS MAINLAND	Chemical Imo II	7700
BESIKTAS ORIENT	Chemical Imo II	4100
BESIKTAS PERA	Chemical Imo II	4100
BESIKTAS GALATA	Chemical Imo II	4100
BESIKTAS CHAMPION	Chemical Imo II	4100
ULUSOY 14	RO-RO	4094 lanemeter
LADY SALİHA	Bulk Carrier	30125
LADY BEGÜM	Bulk Carrier	30125
LADY DEMET	Bulk Carrier	30125
SERVET ANA	Bulk Carrier	30125
LADY SERRA	Bulk Carrier	30125
EYLÜL K	Bulk Carrier	20000
M/T PULI	Chemical Imo II	15000
Under Process		
ECE NUR K	Oil & Chemical Tanker	18000
GUNES K	Oil & Chemical Tanker	20000
TOLI	Oil & Chemical Tanker	6000
HACI İSMAİL KAPTANOĞLU	Product Tanker	50000
LEYLA K	Aframax Crude Oil tanker	115000
ESER K	Aframax Crude Oil tanker	115000
ZEYNEP K	Bulk Carrier	81000
SADAN K	Bulk Carrier	81000